National Institute of Environmental Health Sciences

On the basin-scale detection and attribution of human-induced climate change in monsoon precipitation and streamflow

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Abstract:

Detecting and quantifying the presence of human-induced climate change in regional hydrology is important for studying the impacts of such changes on the water resources systems as well as for reliable future projections and policy making for adaptation. In this article a formal fingerprint-based detection and attribution analysis has been attempted to study the changes in the observed monsoon precipitation and streamflow in the rain-fed Mahanadi River Basin in India, considering the variability across different climate models. This is achieved through the use of observations, several climate model runs, a principal component analysis and regression based statistical downscaling technique, and a Genetic Programming based rainfall-runoff model. It is found that the decreases in observed hydrological variables across the second half of the 20th century lie outside the range that is expected from natural internal variability of climate alone at 95% statistical confidence level, for most of the climate models considered. For several climate models, such changes are consistent with those expected from anthropogenic emissions of greenhouse gases. However, unequivocal attribution to human-induced climate change cannot be claimed across all the climate models and uncertainties in our detection procedure, arising out of various sources including the use of models, cannot be ruled out. Changes in solar irradiance and volcanic activities are considered as other plausible natural external causes of climate change. Time evolution of the anthropogenic climate change "signal" in the hydrological observations, above the natural internal climate variability "noise" shows that the detection of the signal is achieved earlier in streamflow as compared to precipitation for most of the climate models, suggesting larger impacts of human-induced climate change on streamflow than precipitation at the river basin scale.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Extreme Weather Event, Food/Water Security

Extreme Weather Event: Flooding

Geographic Feature:

resource focuses on specific type of geography

Freshwater

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: India

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Methodology

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content